

Article

Bidding against each other: local procurement of personal protective equipment in the context of decentralization and high socio-economic inequality

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Under the influence of fiscal federalism and government decentralization theories, a significant part of health systems around the world confronted the COVID-19 pandemic after being shaped or re-shaped by processes of devolution from central to local governments. Procurement of key supplies is one of the components that operate in a decentralized manner, forcing local governments to compete against each other. This was the origin of what has been called the “bidding wars” between subnational governments at the beginning of the pandemic response. These wars led to centralization policies in the United States, the United Kingdom, and the European Union. Yet, less is known about cases from the Global South. By analyzing the procurement of Personal Protective Equipment (PPE) in the 320 Chilean municipalities in charge of primary health, this research provides evidence of the impacts of horizontal government competition on the ability to procure key supplies. In Chile, during the 2020 response to the pandemic, richer municipalities were able to procure more face masks per population, while economies of scale rewarded bigger purchases with lower prices. The authors support the theoretical notion of “concurrency” as a concept that adds nuances to the centralization-decentralization debate. In Chile, for instance, while testing and tracking required decentralization, PPE purchases could have probably benefited from centralization in order to avoid reproducing territorial inequalities.

Keywords: COVID-19; personal protective equipment; inequality; surgical masks; Chile.

DOI: <https://doi.org/10.1590/0034-761220220325x>

ISSN: 1982-3134 

Article received on October 20, 2022 and accepted on July 23, 2023.

[Original version]

Editor-in-chief:

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Peer review report: the peer review report is available at this [URL](#).

Concursos públicos: aquisição local de equipamentos de proteção individual no contexto de descentralização e elevada desigualdade socioeconômica

Sob a influência do federalismo fiscal e das teorias de descentralização governamental, uma parte significativa dos sistemas de saúde em todo o mundo enfrentou a pandemia da COVID-19 depois de terem sido moldados ou remodelados por processos de transferência dos governos centrais para os governos locais. A aquisição de suprimentos essenciais é um dos componentes que operam de forma descentralizada, forçando os governos locais a competir entre si. Esta foi a origem do que foi chamado de “guerras de licitações” entre governos subnacionais no início da resposta à pandemia. Essas guerras levaram a políticas de centralização nos Estados Unidos, no Reino Unido e na União Europeia. No entanto, sabe-se menos sobre os casos do Sul Global. Ao analisar a aquisição de Equipamentos de Proteção Individual (EPI) nos 320 municípios chilenos responsáveis pela saúde primária, esta pesquisa fornece evidências dos impactos da competição governamental horizontal na capacidade de adquirir suprimentos essenciais. No Chile, durante a resposta à pandemia de 2020, os municípios mais ricos conseguiram adquirir mais máscaras faciais por população, enquanto as economias de escala recompensaram compras maiores com preços mais baixos. Os autores apoiam a noção teórica de simultaneidade como um conceito que acrescenta nuances ao debate centralização-descentralização. No Chile, por exemplo, embora os testes e o acompanhamento exigissem a descentralização, as compras de EPI poderiam provavelmente ter beneficiado da centralização, a fim de evitar a reprodução de desigualdades territoriais.

Palavras-chave: COVID-19; equipamento de proteção pessoal; desigualdade; máscaras cirúrgicas; Chile.

Competiendo entre sí: adquisición local de equipos de protección personal en un contexto de descentralización y alta desigualdad socioeconómica

Bajo la influencia del federalismo fiscal y las teorías de la descentralización gubernamental, una parte importante de los sistemas de salud de todo el mundo enfrentaron la pandemia de COVID-19 después de haber sido moldeados o reformados por procesos de transferencia de poderes de los gobiernos centrales a los locales. La adquisición de suministros clave es uno de los componentes que opera de manera descentralizada, lo que obliga a los gobiernos locales a competir entre sí. Este fue el origen de lo que se ha llamado las “guerras de licitaciones” entre gobiernos subnacionales al comienzo de la respuesta a la pandemia. Estas guerras llevaron a políticas de centralización en Estados Unidos, Reino Unido y la Unión Europea. Sin embargo, se sabe menos sobre los casos del sur global. Al analizar la adquisición de Equipos de Protección Personal (EPP) en 320 municipios chilenos encargados de la atención primaria de salud, esta investigación proporciona evidencia de los impactos de la competencia gubernamental horizontal en la capacidad de adquirir suministros clave. En Chile, durante la respuesta a la pandemia de 2020, los municipios más ricos pudieron adquirir más mascarillas por habitante, generándose con ello economías de escala que les permitieron acceder a precios más bajos, a diferencia de aquellos municipios con menores recursos. Los autores apoyan la noción teórica de “conurrencia” como un concepto que añade matices al debate sobre centralización-descentralización. En Chile, por ejemplo, si bien el testeo y la trazabilidad de casos SARS-CoV-2 requerían la descentralización de dichas funciones, las compras de EPP probablemente podrían haberse beneficiado de la centralización de los procesos de adquisición para evitar la reproducción de desigualdades territoriales.

Palabras clave: COVID-19; equipos de protección personal; desigualdad; máscaras quirúrgicas; Chile.

ACKNOWLEDGEMENTS

The author Felipe Livert acknowledges support from Margarita Salas Postdoctoral Fellowship, which is funded by the European Union-Next GenerationEU and Ministry of Universities, Spanish Government. The author Nicolás Valenzuela-Levi gratefully acknowledges the financial support by Centro de Desarrollo Urbano Sustentable (CEDEUS), ANID/FONDAP/15110020, and ANID/Fondecyt Iniciación/11221325. The author Paola Bordón acknowledges support from ANID/FONDAP/15130009.

1. INTRODUCTION

The COVID-19 pandemic has reproduced and amplified health inequalities within different social, economic, and cultural contexts. In the Global North, scholars that have long ago studied health inequalities – thanks to data and insights from strong welfare states – have highlighted that the pandemic exposed and amplified underlying inequalities in society (Rimmer, 2020). In the Global South, existent inequalities translated into gaps in capacities for implementing preventive measures to tackle the spread of the pandemic, and also to provide an adequate healthcare response (Okoi & Bwawa, 2020). Latin America, among all regions, suffered serious problems to sustain the supply of critical medical resources, mostly imported from other regions, especially during the first months of 2020 (Rubin et al., 2020). In this article, we use the case of Chile to explore how the COVID-19 pandemic produced new disparities related to health services. We specifically look at the procurement of Personal Protective Equipment (PPE) and engage in the centralization-decentralization debate that has emerged after the COVID-19 response.

Differentiated access to PPE was a proxy of the more broad issue of inequalities in the provision of health services (R. Rocha et al., 2021). These were part of the conditions that define COVID-19 as a “syndemic pandemic”. According to Bambra, Riordan, Ford, and Matthews (2020), a syndemic can be identified when the overall health status of a population is significantly affected by a set of health problems that are closely intertwined and mutually enhancing, being these problems part of social conditions that are perpetuated along time. In this sense, resource inequality in health systems during COVID-19 was previously part of risk factors that were linked to comorbidities in an intertwined and cumulative process. The syndemic is, thus, intrinsically linked to health inequalities, which can be defined as “avoidable, unfair and socially unjust systematic differences in health between different sub-groups of a population” (Coronini-Cronberg, Maile, & Majeed, 2020, p. 179). These sub-groups might be defined by income, education, gender, or ethnicity. Yet, an increasing interest has been put on location and territorial inequalities, since the place of residence influences many inequality dimensions and risk factors.

This research looks at the process of public procurement of PPE in the midst of the pandemic, to understand the way territorial inequalities among local governments interacted with availability of basic health supplies. To do so, the case of Chile and its municipal governments is analyzed thanks to new data surveyed by the research team. Chile is an example of how the link between pre-existing inequalities and the impacts of the pandemic do not occur in a vacuum: among others, geographical and institutional factors are part of how the mechanisms for amplifying socio-economic inequalities to other spheres operate. Specifically, here we exemplify the role of the spatial decomposition of socio-economic inequality within a country (Shorrocks & Wan, 2005), and of the devolution of primary health services to local authorities (Kaufman & Jing, 2002; Kleider, 2018; Rodríguez-Pose & Gill, 2004), which in Chile ended up involved in “bidding wars” to procure PPE for their primary health workers (Barlow, Schalkwyk, McKee, Labonté, & Stuckler, 2021).

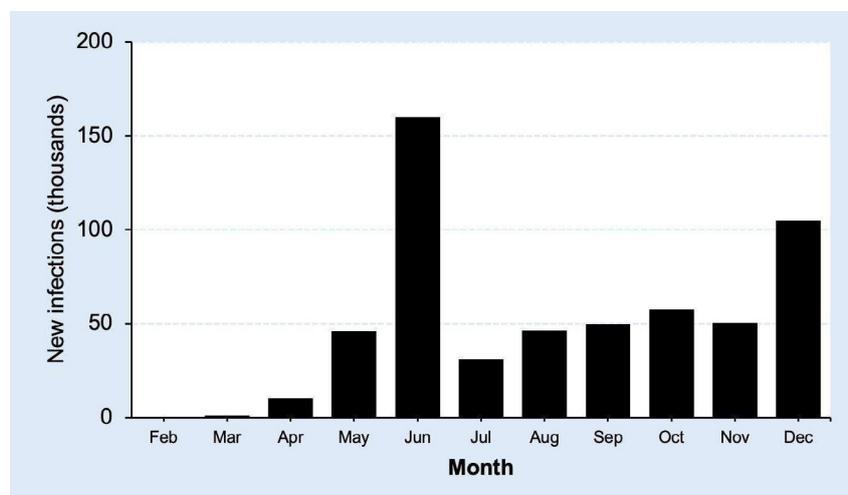
2. CASE STUDY: CHILE DURING THE COVID-19 RESPONSE

2.1 The COVID-19 in Chile

The arrival of the pandemic in countries like Chile is a story that is inseparable from inequality. As explained by Pablos-Méndez, Vega, Aranguren, Tabish, and Raviglione (2020), in most Latin American countries, the pandemic reached the local population after the wealthy returned from vacations in Europe and the United States. Not only this origin illustrated long standing social inequalities, but further analyses have shown that income inequality and poverty levels have been correlated with the spread of the COVID-19 in Latin American cities (Bolaño-Ortiz et al., 2020). Chile is not only one of the most unequal countries in the world (Palma, 2011, 2014; Rodríguez-Weber, 2018), but also a society that is highly territorially segregated (Garreton, Basauri, & Valenzuela, 2020). The spread of the COVID-19 pandemic thus reproduced and amplified existing inequalities and segregation (Bennett, 2021; Farris & Sarricolea, 2020; Vergara-Perucich, Correa-Parra, & Aguirre-Nuñez, 2020).

Furthermore, in Chile, the initial response by the government focused on “dynamic quarantines” in wealthy counties. According to existing reports, the “targeted approach was ineffective because residents quickly infected their domestic employees, who subsequently introduced the virus into their respective communities” (Pablos-Méndez et al., 2020, p. 1). Widespread community testing was not implemented, leading to a peak of contagions and deaths in June (Figure 1), when Chile “had one of the world’s highest confirmed infection rates” (Pablos-Méndez et al., 2020, p. 1). A study on Santiago, the capital of the country that concentrates 40% of the population, showed that the “dynamic quarantines” only contained infection rates in affluent counties, but were ineffective when later applied in the middle- and lower-income areas (Bennett, 2021). Another study at a national level showed similar results when looking at the effectiveness of the dynamic quarantine strategy for the 16 regions of the country (Grebe et al., 2020).

FIGURE 1 NEW COVID-19 CASES PER MONTH IN CHILE (2020)



Source: Elaborated by the authors based on Ministerio de la Ciencia (2021).

Scholars, medical associations, and scientific societies issued early warnings and requests to increase testing and tracking (Canals, 2020), and recommended getting primary health centers involved in the national strategy instead of focusing only on hospitals (Artaza, 2020). However, extensive testing and tracking strategies were only applied “after the peak of COVID-19 cases and deaths” in Chile (Benítez et al., 2020, p. 528).

The lack of an early national community testing and tracking strategy was key to the failure of any containment of the spread of the virus (Bennett, 2021; Pablos-Méndez et al., 2020). The initial response policy focused on involving hospitals instead of primary health infrastructure (Artaza, 2020), with an emphasis on increasing availability of intensive care beds and ventilators (Pablos-Méndez et al., 2020). Moreover, hospitals in Chile are clustered in a reduced number of counties, which concentrate population and wealth (Arteaga, Astorga, & Pinto, 2002). In addition to existing income disparities between counties, health inequalities also exist due to the mixed public-private nature of the Chilean health service supply. As documented by Bennett (2021), increases in testing in Chile involved a surge in the share of testing by private centers. “Testing was more extensive in the private sector, where patients got tested with a lower probability of actually being infected. The difference between private and public center availability becomes particularly relevant when we consider that in high-income counties that had lockdown policies only 32% of residents were subscribed to the public health care system in 2017, while that number was 78% for lower-income areas that had quarantines before May 5th” (Bennett, 2020, p. 7).

As late as June 2020, local authorities became finally in charge of testing and tracking, which implied a new, non-planned pressure to ensure adequate PPE for those workers in charge of the new community-oriented response that was deployed outside main hospitals (Benítez et al., 2020). Surgical masks became the most used element to provide face protection Chilean primary health workers, who had to operate in midst of the pandemic since March but became in charge of the national strategy for testing and tracking after three months. As it is developed in the rest of the paper, the ability to purchase PPE by municipalities was linked to pre-existing socio-economic inequalities between counties.

2.1 Health inequalities in Chile

Inequalities in diverse health indicators have been documented in Chile according to social class (K. B. Rocha et al., 2013), socio-economic status (Pino-Cortés et al., 2020), migration status (Cabieses et al., 2017), and county of residence (Sánchez & Albala, 2004). Disparities in historic indicators such as infant mortality rates, although have seen progress, by 2010 kept showing significant inequalities in Chile (Flores & Cerda, 2010). Unequal distribution of risk factors is also part of these health inequalities: the link between pollution and health inequalities has been long ago documented and debated in Chile (Castán-Broto & Sanzana-Calvet, 2020; Ostro, Sanchez, Aranda, & Eskeland, 1996, Pino-Cortés et al., 2020).

Part of existing health inequalities in Chile have to do with gaps in resources between municipalities, derived from disparities in household income. In 320 out of the 345 Chilean counties,

the public primary care services are a responsibility of each local authority. Their budget depends on grants from the central government and autonomous municipal revenue, which leads to a strong correlation between county-level wealth and financial resources to provide health care. Riquelme-Briceño, Haase-Delgado, Lavanderos-Bunout, and Morales-Martínez (2017) analyzed inequality in primary healthcare financial resources among Chilean counties between 2001 and 2013, finding a 75% increase in the Gini coefficient – a measure of inequality – for *per capita* spending and a 30% increase in the Gini for investment. Deficiencies in primary health are linked to difficulties in hospitalization: Ipinza-Riveros (2005) discussed that delays and collapse in public hospitals are linked to derivations that should have been taken care of by primary health services. Fuenzalida and Carvajal (2019) showed how, even within the capital city of Santiago, strong inequalities arise among residents from different counties when it comes to hospital derivations related to diabetes. Residents from poorer and more distant districts have less alternatives than those from more central areas.

The Chilean liberal economic model, which has been largely studied in its relation with income and wealth inequality (Palma, 2011, 2014; Rodríguez-Weber, 2018) can also partly explain health inequalities that are related to hospital infrastructure. Goyenechea (2019) outlines the process of introducing market rationale to the Chilean public hospitals, in tandem with the growth of private sector providers. In the last decades, the latter includes outsourcing hospitalization services from overcrowded public facilities to private clinics. Goyenechea (2019) claims that these outsourcing policies have reinforced under-investment in public hospital infrastructure. As a vivid example of these dynamics, during the COVID-19 pandemic, Bennett (2021) found that the differences between areas covered mostly by public and private health providers was linked to significant distortions in testing: paid private clinics did more testing, with lower positivity rates.

Within the literature from the Global North, Hull, Williams, Basnett, and Ashman (2021) have signaled that the deficit of hospital referrals during the COVID-19 crisis, due to overwhelmed sanitary infrastructure, has worsened existing inequalities and is most marked for those aged 50 and over. In the case of Chile, COVID-19 related hospitalizations have been distributed both within public and private infrastructure via State of Exception executive acts. However, it remains to be seen whether non COVID-19 related derivations are being linked to new health inequalities. In this sense, by studying procurement of critical PPE during the shock of the COVID-19 pandemic, we are able to document a new form of health-service inequality: that of the ability to protect the primary health workers, which might critically affect the response to the pandemic at the local level and have profound social consequences in the future.

3. THEORETICAL FRAMEWORK

3.1 Centralization versus decentralization during the COVID-19 pandemic

The response to the pandemic prompted a wide debate on the tension between centralization and decentralization of government (Greer et al., 2022; S. Park & Fowler, 2021; Schomaker, Hack, & Mandry, 2021; Stasavage, 2020; Weng, Ni, Ho, & Zhong, 2020; Yang, 2020; Zahariadis, Petridou,

Exadaktylos, & Sparf, 2023). In general, the literature recognizes advantages and disadvantages on both policy orientations. Taken to the extremes, the COVID-19 pandemic provided cases of democratic and decentralized responses, on the one side, as well as centralization under authoritarian rule, on the other side. More decisive action in a centralized setting might be linked to information suppression that leads to ignoring local problems, while, although it might be impossible to hide problems when power is truly decentralized, responses can be slower and ineffective (Stasavage, 2020).

Beyond abstractions, the empirical evidence showed mixed tendencies. For instance, a study of the pandemic response in 19 federal systems showed that most of them became more centralized during the initial stages of the spread of the SARS-CoV-2 virus, but later presented diverse paths of continuing centralization *versus* returning to decentralization (Steytler, 2021). From a theoretical standpoint, also while analyzing COVID-19 responses, Lele (2023) proposed the concept of concurrency as an alternative lens to the centralization-decentralization debate. In this view, both policy orientations could be applied simultaneously at different levels, which would nonetheless require strong capacity to absorb increased institutional complexity.

At the local level, no other issue better represents this centralization-decentralization debate like devolution of health services. Devolution is the process of handing competences and responsibilities from national to local governments, which can involve regional, provincial, or municipal administrations. This devolution process has shaped the landscape of public health services in regions as diverse as Europe (Diamond & Laffin, 2022; Warner, Richards, Coyle, & Smith, 2021), Asia (Khan, Nazir, Afzal, & Sohail, 2023), Africa (Ochieng' -Springer, 2022) and Latin America (Riquelme-Briceño et al., 2017).

In general, it has been found that, while devolution can promote more adequate local solutions to primary health needs, responsibilities devolved to the local level are rarely matched with equivalent decentralization of financial resources. For instance, although the local pandemic response by city councils was praised in the United Kingdom, resource distribution by central government grants was described as “begging-bowl devolution” (Warner et al., 2021). Devolution was thus studied as part of the institutional factors influencing the COVID-19 response (Ramírez-de-la-Cruz, Grin, Sanabria-Pulido, Cravacuore, & Orellana, 2020). In the case of England, Warner et al. (2021) found that pre-existing health inequalities and unequal central grant allocation contributed to worse outcomes from COVID-19 among local entities. Similarly, Khan et al. (2023) found that devolution was associated with lack of coordination of the pandemic response among Pakistan’s provincial governments. In Kenya, Ochieng' -Springer (2022) claims that, while devolution was intended as a mechanism to curb inequality, create more inclusive governance, as well as to enhance service delivery throughout the country, the reality during the pandemic response was one of lack of basic resources to provide adequate health services at the local level.

3.2 Decentralization and cost-efficiency

Procurement of health supplies is one of the key elements of the interaction between decentralization of government and health inequalities in the midst of the COVID-19 pandemic. Decentralization of procurement processes emerged as a response to direct and indirect costs from purchases (Nemec,

Đuricová, & Kubak, 2023). These costs have been acknowledged by the institutional economics literature since the mid-20th century, specifically by the theorists of fiscal decentralization (Xie, Ren, & X. Wang, 2022). Buchanan (1950) argued in favor of federalism and decentralization as a tool for fiscal equity and efficiency. Theoretically, competition between local governments would involve providing products and services to attract human capital, funds, technology, resources in general and, most importantly, votes. At the local level, in a much more efficient way than the national scale, democracy would provide a form of processing information of people's needs through electoral preferences. Furthermore, Tiebout (1956) introduced the notion of "voting with one's feet" to exemplify competition between local governments and opened up the field of local competition research. Oates (1972) recognized both the ability of local governments to understand voters' preferences, on the one hand, and, on the other hand, the specific instances in which aggregation of public buyers might promote efficiency in procurement spending, thanks to economies of scale (Nemec et al., 2023).

The force behind the theoretical causal mechanism that links fiscal decentralization with efficiency can be named as intergovernmental competition (H. Park, 2021; Zheng & Warner, 2010), government competition (Breton & Fraschini, 2007) or horizontal competition (Xie et al., 2022). These logics of competition are seen not only as a way of generating a closer link between the volume of goods and services produced by local governments and prices paid for them by citizens, but also as a force to discipline public sector actors (Breton & Fraschini, 2007). Local competition research has produced examples of government competition, particularly in terms of taxation and environmental regulation as factors that make people and companies to "vote with their feet" (Xie et al., 2022). Moreover, depending on the incentive structure put in place under different institutional regimes, competition is not reduced to funds, prices, goods, and services, but also to political favor, credit and blame among public officials (Greer et al., 2022; Xie et al., 2022).

Local competition research during the COVID-19 response also provided instances of difficulties generated by decentralization in the context of the emergency. Xie et al. (2022) uses the concept of "scrambling" to describe horizontal competition among Chinese local governments in the context of three emergencies, including COVID-19. Yet, the most used term to describe horizontal competition between governments is "bidding wars." Although the term was previously used for competition over taxation, carbon emissions, infrastructure investment and funding of social benefits among local governments, it acquired greater prominence during 2020, particularly in the United States. There, "bidding wars" was used to describe competition for Personal Protective Equipment (PPE) among states and between the states and the federal government. The most famous quote came from Andrew Cuomo, the Governor of New York, who equaled procurement for PPE to "being on eBay with 50 other states, bidding" (S. Park & Fowler, 2021, p. 292).

3.3 The decentralization-centralization tension in procurement during the COVID-19 response

PPE was a critical resource for the response to the pandemic. Many regions of the world were pushed to their limits in terms of the ability to procure basic medical supplies (Rubin et al., 2020). The pressure on the supply chain included surgical masks and N95 respirators, which have been deemed crucial

PPE for health workers. Anticipating the risk of shortages, the World Health Organization (WHO) promptly recommended giving priority to the use of face masks only for those in contact with patients (Abd-Elseyed & Karri, 2020).

These risks were confirmed later by shortages in several countries, which led some to refer to a “mask crisis” during the COVID-19 outbreak (M. W. Wang et al., 2020). Actual experience of shortages, or fear of them, led the health personnel to try alternatives such as sub-standard equipment (Abd-Elseyed & Karri, 2020) and disinfection and sterilization for reuse (Rubio-Romero, Pardo-Ferreira, Torrecilla-García, & Calero-Castro, 2020). These shortages of PPE affected the ability of health workers to protect themselves and evidenced the need to understand the dynamics within the PPE markets (Godoy et al., 2020; Houghton et al., 2020). Lack of proper PPE became part of the syndemic (Bambra et al., 2020), as a factor behind the adjacent causes that generated health inequalities in terms of the impact of the COVID-19 pandemic. In their account of health inequalities in Brazil during COVID-19, R. Rocha et al. (2021) used PPE as a variable to analyze, expecting a significant link between scarcity in more specific equipment and weakness of overall health infrastructure and hospital capacity.

Public procurement is expected to be more cost-effective under certain institutional factors. These factors are transparency, competition, the ability of buyers to select the most advantageous tendering methods, and defining adequate bidder selection criteria (Nemec et al., 2023). However, pandemic times are seen by the literature as a risk of inefficient procurement because governments tend to increase spending substantially and rapidly (Blanco-Varela, Quintas-Pérez, Sánchez-Carreira, & Mourão, 2020). Furthermore, the COVID-19 response has also been a moment of risk of corruption in the procurement of health supplies (Blanco-Varela et al., 2020; Nemec et al., 2023; Rose-Ackerman, 2021). These institutional challenges occurred in tandem with a collapse of the global supply chains, which involved the whole structure of the international business of PPE production, commercialization, and distribution. This collapse went from quality controls, risk management, sourcing operations, micro strategic management, norms of cooperation and competition, business ethics, tariffs, and terms of trade, to international politics (Soelberg, 2022).

In regions such as Latin America (Rubin et al., 2020) and Africa (Ochieng’-Springer, 2022), which depend on PPE imports and lack local manufacturing power, the collapse in the supply chain had more dramatic effects. However, even in more affluent contexts, such as the United States (S. Park & Fowler, 2021) and the European countries (Schomaker et al., 2021), “bidding wars” or “scrambling” for supplies generated a new form of inequality between subnational territories, in the form of undersupply of critical resources.

In most cases, the response to the chaos generated by horizontal competition under a diminished supply of PPE, led to the centralization of the procurement processes for health equipment. In the United States, after the “bidding wars”, the federal government started purchasing PPE and later the President used the Defense Production Act to compel 3M Company to produce supplies (S. Park & Fowler, 2021). After an initial phase, the European Union launched a joint procurement process of PPE among its members (Schomaker et al., 2021). In the United Kingdom, competition for PPE initiated among the National Health Service (NHS) boards, which led the central government to

intervene in coordinating and distributing PPE (P. Anderson, 2021). In Brasil, states competed for PPE, leading some state authorities to request the federal Ministry of Health to concentrate the purchase of medical and hospital equipment (Pereira, Oliveira, & Sampaio, 2020).

3.4 Hypotheses

The case of Chile is an example of “bidding wars” between municipalities (see Section 3), in a context of strong socioeconomic inequality and spatial segregation. Based on the literature, three are the main hypotheses to be tested using the Chilean context:

H₁: Differences in wealth among counties is associated with the ability of each local primary health service to procure PPE for their health workers.

H₂: Counties that are more distant to capitals did not have the help from private clinics or public hospitals to assist their community, and therefore endured relatively higher demand for PPE.

H₃: In the context of horizontal competition in procurement during the COVID-19 response, economies of scale were associated with lower prices of PPE.

H₁ is tested by means of looking for a variable that reflects availability of funds among municipalities. H₂ is tested by means of looking at the distance between municipalities and the location of hospitals. H₃ is tested by means of observing the price paid for PPE. The details of the definition of variables, the methodologies used, and the data collection are developed in the next section.

4. DATA AND METHODS

4.1 Data and methodology

We base our research on primary data that was collected from the national registry of public procurement, managed by the Chilean National Directorate of Public Procurement (Dirección Nacional de Compras y Contratación Pública [DGCP], 2020). The data includes each purchase generated by any entity from the public sector. We focused on the acquisition of face masks by the 320 municipalities to which primary health has been devolved. Among the recorded values, we were able to define, for each purchase, the type of masks, quantity acquired, price paid, the date of the purchase, and the municipality that bought the equipment. We then generated monthly aggregates by county, in order to have a panel of comparable indicators. The data extraction occurred in January 2021, which allowed us to have data for the period January of 2020 to December of 2020. Due to the stress among municipal public servants and the quick need to purchase PPE, the raw data included aggregated amounts that did not distinguish boxes or units or types of masks. Thus, an additional cleaning data process involved looking at each purchase order and invoices, so to obtain unitary prices, total amounts and types of masks purchased. We also included a series of characteristics from each county, such as municipal autonomous revenue *per capita*, density and distance from regional capitals, that were available on the

public database published online by the Ministry of the Interior (Ministerio del Interior, 2020). Table 2 shows the summary statistics.

TABLE 2 SUMMARY STATISTICS

Variable	Obs.	Mean	Std. Dev
ln (masks/population)	3,594	-3.248	1.922
ln price (USD)	3,594	-1.154	0.864
ln price N95 (USD)	2,079	0.203	0.810
Distance to regional capital (Km)	3,594	91.503	77.642
Autonomous municipal revenue <i>per capita</i> (USD)	3,577	85.234	123.29
Lockdown (days)	3,559	8.409	25.618
COVID cases (number)	3,556	1115.198	2523.319
Density (people/Sq. Km)	3,594	914.163	2852.489

Source: Elaborated by the authors.

In order to compare the availability of PPE, we use the number of masks per population (Mpp) as the dependent variable, since this *per capita* indicator allows us to compare primary health providers accounting for the variance in the size of the communities they serve. We specifically target surgical masks, since the data collected showed that this type represented 74.5% of the units acquired by local authorities during 2020, followed by N95 respirators with 21.5%, and a 4% composed of different sub-standard alternatives.

We thus define the dependent variable as:

$$Mpp_{it} = M_{it} / P_i$$

Where Mpp_{it} is the number of masks acquired (stock) *per capita* in the municipal district i during month t ; M_{it} is the quantity of masks purchased by the county i during the month t , and P_i is the total population estimated for year 2020 in county i . We use an ordinary least squares (OLS) multivariate linear regression model to estimate how variables associated to the pandemic, inequalities between counties, and district characteristics, are linked or not to the capacity to generate stock of surgical masks.

The regression specification is:

$$\ln Mpp_{it} = \beta_1 + \beta_2 \ln Price_{it} + \beta_3 AMRpc_i + \beta_4 Distance_i + \beta_5 Lockdown_{it} + \beta_6 Cases_{it} + \beta_7 Density_i + \gamma_t + \varepsilon_{it}$$

Where $\ln Mpp_{it}$ is the natural logarithm of masks purchased *per capita* by county i during month t ; $\beta_{(2...7)}$ are the coefficients of interest for each factor and control variables; $Price_{it}$ is the mean price of surgical masks in all purchases during month t by county i ; $AMRpc_i$ is autonomous county revenue *per capita* in county i during 2019; $Distance_i$ is the distance in kilometers between the centroid of the county and the centroid of the regional capital; $Lockdown_{it}$ is the number of days during which the municipality i went under lockdown during month t ; $Cases_{it}$ is the total new confirmed COVID-19 cases per month t in the county i ; γ_t capture time effects, that is, from month 1 to 12; $Density_i$ is the population density of each county i registered for 2019, measured by the number of people per square kilometer. $AMRpc$ is used here as a proxy of the wealth of each district, since autonomous revenue is correlated to factors such as land value, the income of the residents and economic activities in the territory (Ahmad, Letelier, & Ormeño, 2015).

Since our dependent variable is the quantity of surgical masks purchased, it also affects the price of masks, also known as reverse causality, which in turns makes the variable price endogenous. Therefore, we use an instrument for price that has been used in the industrial organization literature, the price of substitutes (Angrist & Krueger, 2001; Berry, Levinsohn, & Pakes, 1995; Genesove & Mullin, 1998) in a two-stage least squares (2SLS) regression model.

The first stage equation is then defined by:

$$\ln Price_{it} = \alpha_1 + \alpha_2 Price\ N95_{it} + \alpha_3 AMRpc_i + \alpha_4 Distance_i + \alpha_5 Lockdown_{it} + \alpha_6 Cases_{it} + \alpha_7 Density_i + \gamma_t + \varepsilon_{it}$$

Where $Price\ N95$ is the mean price of N95 type masks at municipality i at month t . N95 masks are substitutes of surgical masks, although there are less purchases of N95 masks by municipalities, it still performs well as an instrument.

The second stage is then the following:

$$\ln Mpp_{it} = \beta_1 + \beta_2 \widehat{\ln Price}_{it} + \beta_3 AMRpc_i + \beta_4 Distance_i + \beta_5 Lockdown_{it} + \beta_6 Cases_{it} + \beta_7 Density_i + \gamma_t + \varepsilon_{it}$$

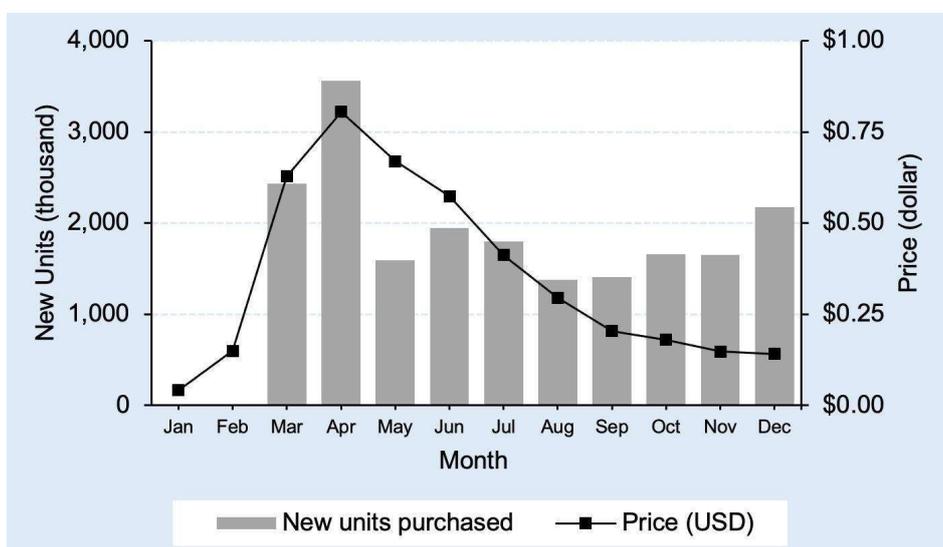
Since our objective is to know whether wealth and procurement of Mpp was correlated, and based on the discussion from Sections 3, 4, and 5, the main variables that we pay attention to are (1) $Price$, (2) $AMRpc$, as a proxy of the wealth of the inhabitants of each district, which translates into funding for primary health (Riquelme-Briceño et al., 2017), and (3) distance to the regional capital as a proxy of distance to the main hospital infrastructure.

5. RESULTS

As shown in Figure 2, it is possible to identify three moments regarding mask purchases during 2020. A first moment of “rush” followed the arrival of the virus and reached a peak of both purchases and average price in April. A second moment of “stabilization” occurred between May and September, with a peak of new cases (Figure 1), stable purchases and prices gradually falling. A third moment of “new normalcy” began in October, with prices in November reaching similar levels to those in February: these last two months, in a context of lower infection rates, seems to be a moment of procuring stock in order to plan for 2021.

Figure 2 also shows the mean price among all purchases, which jumped from USD 0.17 in February to USD 0.88 in April, slowly decreasing afterwards. After the peak in purchases during April, there is another smaller increase during June and July. This rise could have been due to external factors such as some sort of increase in international supply since June – we do not have the data to confirm or discard such hypotheses. However, this increase during June and July occurred in tandem with new tracing and diagnose responsibilities regarding the COVID-19 response being decentralized towards local primary health care services in Chile since June. It seems likely that these new responsibilities pushed for additional purchases.

FIGURE 2 NUMBER AND AVERAGE PRICE OF SURGICAL MASKS PURCHASED PER MONTH IN CHILE (2020)



Source: Elaborated by the authors.

Table 3 summarizes the regression results, which allow us to test whether these differences are linked to the theorized variables. The two numeric columns in the left show the OLS and 2SLS regression outcome with the models specified in Section 2. The two additional columns to the right introduce county dummies, which account for the county-level fixed effects that could be characterized

by omitted variables in the specified regression. These results show that county-level fixed effects increase the explanatory power of the model from 17% to 48% of the variance in *Mpp*.

TABLE 3 REGRESSION RESULTS

	(1)	(2)	(3)	(4)
VARIABLES	OLS	IV	OLS	IV
In Price	-0.393*** (0.0748)	-2.082*** (0.530)	-0.413*** (0.0798)	-1.661*** (0.517)
AMRpc	0.00186*** (0.000199)	0.00169*** (0.000419)	0.0179 (0.0215)	0.00362 (0.0111)
Distance	0.00287*** (0.000417)	0.00443*** (0.000579)	0.00647 (0.0660)	-0.000202 (0.00843)
Lockdown	-0.00142 (0.00146)	-0.00119 (0.00168)	0.00225 (0.00153)	0.00410** (0.00163)
Cases	-0.000216*** (1.66e-05)	-0.000212*** (1.92e-05)	-9.01e-05*** (2.15e-05)	-9.21e-05*** (2.61e-05)
Density	1.41e-05 (1.35e-05)	1.62e-05 (1.70e-05)	0.112 (0.117)	-0.000176** (8.53e-05)
Constant	-3.315*** (0.119)	-7.928*** (1.085)	-15.4 (13.76)	-5.482** (2.355)
Observations	3,539	2,068	3,539	2,068
R-squared	0.170	0.148	0.458	0.482
Municipal FE	NO	NO	YES	YES
Months FE	YES	YES	YES	YES
First Stage F		85.8328		63.5264
p-value		0.0000		0.0000
Durbin (score) p-value		0.0051		0.0558
Wu-Hausman p-value		0.0053		0.0790

Notes: a: Significance levels: * = p-value ≤ 0.1; ** = p-value ≤ 0.05; *** = p-value ≤ 0.01 b: Robust standard errors, reported in brackets.

Source: Elaborated by the authors.

We accept the three hypotheses, since the price was significantly and negatively linked to *Mpp*, while *AMR_{pc}* and distance are significantly and positively correlated to *Mpp*. Those counties with greater wealth and those closer to regional capitals purchased a higher number of surgical masks *per capita*, while economies of scale benefited those who were able to purchase higher quantities. *AMR_{pc}* and distance cease to be significant after introducing county dummies, which means that there are other omitted variables that can account for differences between counties. This result is expected, since these specified explanatory variables are part of a broader set of county-level variables. However, as mentioned above, it is worth noticing that county characteristics and the variables introduced in the model accounted for almost half of the variance of *Mpp*.

Furthermore, results show that higher quantities of surgical masks were acquired at lower market prices, even after controlling for county level fixed effects. The use of instrumental variables confirmed the presence of the expected endogeneity to market prices. The negative coefficient between purchases and prices responds to what is expected in the economic literature (Angrist & Krueger, 2001; Berry et al., 1995; Genesove & Mullin, 1998) and can be interpreted as buyers being responsive to market prices. In other words, while bidding against each other, the 320 counties had to weigh the fluctuations in market prices, and these fluctuations affected their purchase decisions.

Regarding controls, *Cases* were also significant in the regressions, both before and after introducing county dummies: the higher the number of infections, the lower the number of *Mpp*. The objective of this study was not to explore the causal link between procurement of PPE and infections, and therefore this correlation must not be interpreted as an effect. However, new COVID-19 cases are fundamental controls to observe the relationship between wealth inequalities and procurement: our results are robust to the impacts that the virus was having on each county.

6. DISCUSSION

The interpretation of these results provides relevant elements to discuss both in terms of theory and policy. The reviewed literature (Sections 3.1, 3.2, and 3.3) points toward several elements that can be discussed in light of the results.

First, is possible to make a similar assessment of the interaction between devolution of health services and COVID-19 in Chile, to what has been mentioned in cases such as the United Kingdom, Pakistan, or Kenya (Khan et al., 2023; Ochieng'-Springer, 2022; Warner et al., 2021). Chile is too a case in which decentralization can generate appropriate health responses among municipalities, but also in which resources are not distributed in a way that can mitigate socio economic inequalities between territories managed by municipal authorities. The case of PPE procurement in Chile during the COVID-19 response reflected heterogeneous local needs, resource gaps, and a public procurement process that made market mechanisms to act as amplifiers of existing inequalities between territories.

In this sense, confronted to a similar contingency, it would add resiliency to the Chilean health system to have ways to generate some form of centralized procurement of PPE, with the caveat that effective distribution criteria and logistics need to be in place in order to replace a decentralized competitive market. As mentioned, during the COVID-19 response, this centralized procurement

was a response in the United States, the United Kingdom, and the European Union after initial “bidding wars” (P. Anderson, 2021; S. Park & Fowler, 2021; Schomaker et al., 2021). In theoretical terms, even the most active proponents of fiscal federalism recognized that some cases might require coordination between local governments in order to obtain benefits from economies of scale (Oates, 1972). PPE in the midst of a pandemic would clearly be one of those cases.

Yet, it is worth noting that the COVID-19 response in Chile also reflects other moments in which the health system moved from centralization to decentralization, as it was the case of testing and tracking from June 2020 onwards (Section 2.1). Although the “bidding wars” for PPE among municipalities could have provided reasons to move towards centralization to take advantage of economies of scale, the inadequacy of centralized testing and tracking led to decentralization towards the same municipalities. Consequently, findings from Chile can be used to support the notion of concurrency as a simultaneous process of centralization and decentralization (Lele, 2023) in different components of one coordinated response.

7. CONCLUSIONS

In this study we analyzed the procurement of surgical masks by local primary health care services during the COVID-19 pandemic response in Chile. The country experienced infections since March and national authorities waited until June – moment of peak of infections and deaths – to implement a national-level testing and tracking strategy. Only in June the primary health care services became officially involved in the national strategy. These services are, in the great majority of cases, the responsibility of municipalities, whose financial resources significantly depend on the wealth of their inhabitants.

By tracking public procurement data, we were able to observe an unplanned surge in purchases of surgical masks and a sharp increase in prices. Studying the period between January and December 2020, we found that socio-economic inequality and disparities in hospital infrastructure access between counties was significantly linked to procurement of surgical masks for their health workers. This type of mask represented 74.5% of total units of masks bought by counties in Chile. In this context of unplanned implementation of a response, which occurred in both the peak of infections and deaths in Chile and under a widely strained global market of medical supplies, our analysis signals that the procurement of PPE was linked to existing socio-economic inequalities in Chile. We also were able to observe “bidding wars”, in which municipalities were affected by different local needs and had to respond to fluctuations in market prices.

In a context of a strongly unequal and segregated country like Chile, a critical resource for protecting health workers reproduced existing inequalities, which most likely led to additional health inequalities in the response to and impacts of the COVID-19 pandemic. It seems imperative for future emergencies, to have national instruments for the purchase of critical PPE, one that avoids repeating a scenario in which countries bid against each other, and existing inequalities are exacerbated, to the detriment of the communities that are most in need.

These results provide a better understanding of the procurement process in Chile during the COVID-19 response, but also supports the idea of concurrency as a coordinated process of

centralization and decentralization of different components of the same health response. For instance, while centralization was needed in the case of PPE, decentralization had to be the inevitable response after a flawed centralized testing strategy. By means of diving deep into case studies like Chile, the COVID-19 crisis can be an opportunity for avoiding abstract debates between promoters of centralization and decentralization. Only pragmatic and evidence-based approaches will provide paths towards resilience.

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DATA AVAILABILITY

The entire dataset supporting the results of this study was published in the article itself.